

TOWARDS A SEISMOGENIC SOURCE MODEL OF THE DINARIDES

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Outline

Geology-based seismogenic source models are becoming the fundamental input for seismic hazard assessment at the scale of an entire country. In this work, we illustrate in simple steps the complex process that leads from basic data to a fully-fledged seismogenic source model of the Dinaride thrust belt, running along coastal Croatia, Montenegro and part of Albania.

We started from a layer of basic geological and structural data and explored a wide range of indicators of recent tectonic activity, such as drainage anomalies/diversions and displaced or warped geological markers. We then analyzed the interplay of these indicators with known or prospective tectonic structures. To the picture thus obtained, we added a layer with a revised historical seismic catalog and selected a few earthquakes for which we re-estimate epicenter and magnitude. At the end of our analyses we combined all these data in a structured GIS database. With these data at hand, we also compared the longer-term indicators with present-day stress/strain data such as GPS velocities and earthquake focal solutions.

Following the approach already developed for the construction of the Database of Individual Seismogenic Sources for Italy, we developed a seismogenic source model for the Dinarides in which the better constrained seismogenic faults have been mapped and parameterized and made ready for use in seismic hazard practice.

1. Regional structural and tectonic setting

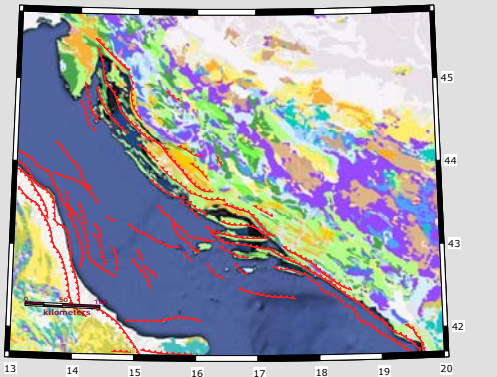


Figure 1: Regional geologic setting and traces of active faults for the coastal and off-shore parts of the Dinaride structure (data on geological formations taken from onegeology internet portal).

3. Historical seismicity

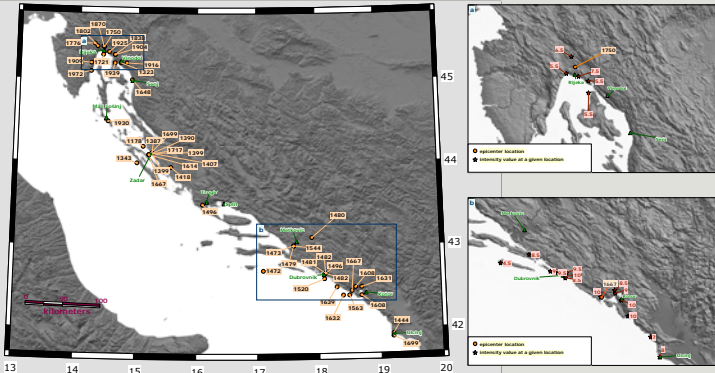


Figure 3: Historical earthquakes along the coastal and off-shore parts of the Dinarides. The figures on the right show two selected historical earthquakes with reported intensity values; the 1750 Rijeka in the upper figure and 1667 Dubrovnik earthquake in the lower figure.

5. GPS vectors

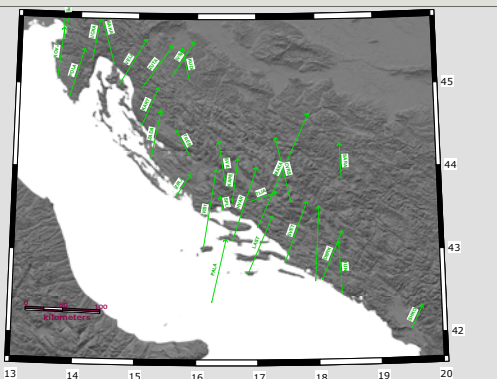


Figure 5: GPS vectors obtained for the area of the Dinarides (data taken from Caporali et al., 2009).

References

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Pondrelli, S., Salinbeni, S., Estrom, G., Morelli, A., Gasperini, P., and Vannucci, G., 2006, The Italian CMT dataset from 1977 to the present: Physics of the Earth and Planetary Interiors, v. 159, p. 286–303, doi:10.1016/j.pepi.2006.07.008.

2. Drainage anomalies and local geological characteristics

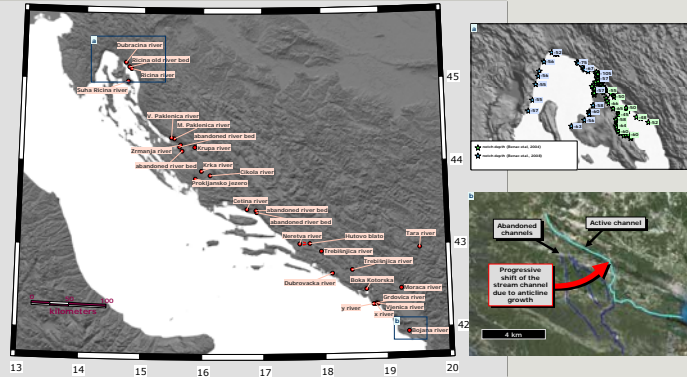


Figure 2: Map of courses of rivers in the coastal parts of the Dinarides with spotted drainage anomalies. Upper right figure shows depth position of submerged marine notch in the Kvarner area (data taken from Benac et al., 2004; Benac et al., 2008). The lower right figure demonstrates hydrographic conditions of Bojana river with a set of abandoned and active river channel.

4. Focal mechanism solutions and orientation of mean S_H stress axis

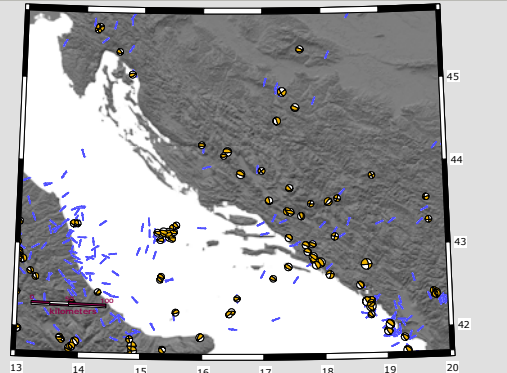


Figure 4: Map of focal mechanism solutions for earthquakes in the Dinaride region (from Pondrelli et al., 2006 together with orientation of mean S_H stress axis obtained from various data sets (taken from Heidbach et al., 2008)).

6. Source model

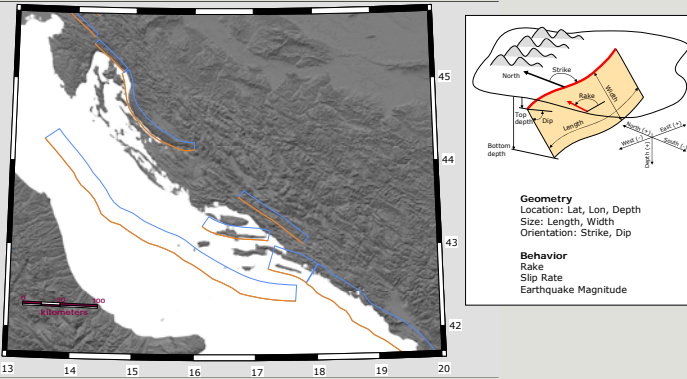


Figure 6: Composite seismogenic sources (see sketch to the right for definition) for the coastal and off-shore parts of the Dinarides. Table shows the values of the parameters depicting each source (data taken from DISS 3.1, 2009).

| IDSource | SourceName | MinDepth | MaxDepth | StrikeMin | StrikeMax | DipMin | DipMax | RakeMin | RakeMax | SlipRateMin | SlipRateMax | MaxMag |
|----------|-------------------------------|----------|----------|-----------|-----------|--------|--------|---------|---------|-------------|-------------|--------|
| HRCSD001 | Mijet | 2 | 15 | 280 | 330 | 30 | 45 | 70 | 110 | 0.12 | 0.5 | 6 |
| HRCSD002 | hrvar | 3 | 15 | 260 | 310 | 40 | 65 | 20 | 70 | 0.1 | 0.45 | 6.1 |
| HRCSD003 | Imotski | 2 | 20 | 290 | 320 | 50 | 70 | 95 | 130 | 0.1 | 0.4 | 6 |
| HRCSD004 | Eastern Mid-Adriatic offshore | 2 | 12 | 270 | 310 | 35 | 60 | 70 | 100 | 0.15 | 0.45 | 5.5 |
| HRCSD005 | Valebit | 2 | 18 | 270 | 340 | 45 | 70 | 80 | 140 | 0.1 | 0.4 | 6 |
| HRCSD006 | Vinodol - Rijeka | 1 | 15 | 310 | 325 | 45 | 60 | 100 | 140 | 0.2 | 0.4 | 6 |
| MECS001 | Montenegro offshore | 1 | 15 | 290 | 330 | 25 | 45 | 60 | 100 | 0.15 | 0.8 | 7.2 |